VGG-CovidNet: A Bi-Branched Dilated Convolutional Neural Network for Detection of COVID-19 Cases from Chest X-Ray Images

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Research

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Abstract

Background: The COVID-19 pandemic continues to have a devastating impact on the worldwide population's health and welfare. A key measure that is taken in combating COVID-19 is effectively screening infected patients. A vital screening process is examination through chest radiology. Initial studies have shown irregularities in the chest radiography images of patients specific to those suffering from the COVID-19 infection. Motivated and inspired by the research community's open source efforts, this study introduces a dilated bi-branched convoluted neural network (CNN) architecture called VGG-COVIDNet, tailored to detect COVID-19 cases from chest X-ray (CXR) images.

Results: The simulation results show that the proposed architecture yielded the highest accuracy and produced the highest sensitivity compared to state-of-the-art architectures. The proposed architecture's accuracy and sensitivity are 96.5% and 96%, respectively, for each of the infection types.

Conclusions: We applied VGG-CovidNet, a VGG-16, and dilated convolution-based bi-branched architecture for classifying different types of infectious images into corresponding classes. The front end of the VGG-CovidNet is integrated with the first 10 layers of the VGG-16 model. In these layers, the convolution is reduced to two instead of three to alleviate the model's computation complexity. Furthermore, the back end of the VGG-CovidNet consists of six parallel convolutional layers having different strides of convolutional kernel. Using the dilated convolution, we can capture the spatial information of the feature maps and help reduce the complexity of the model.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.

Figures

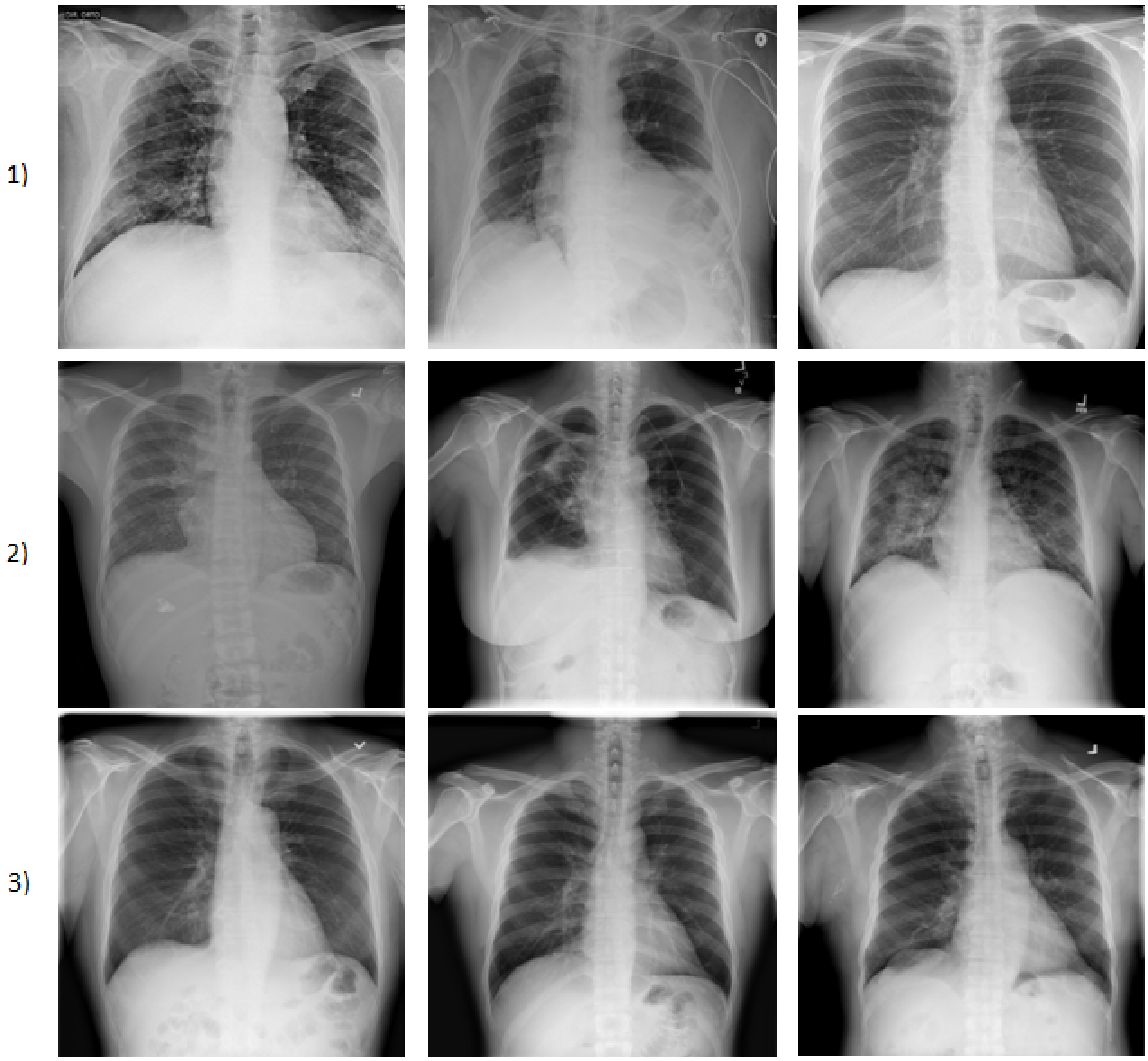

Figure 1

Sample images from COVIDx dataset. 1) COVID-19 images, 2) Non-COVID 19 images, 3) Normal Images.

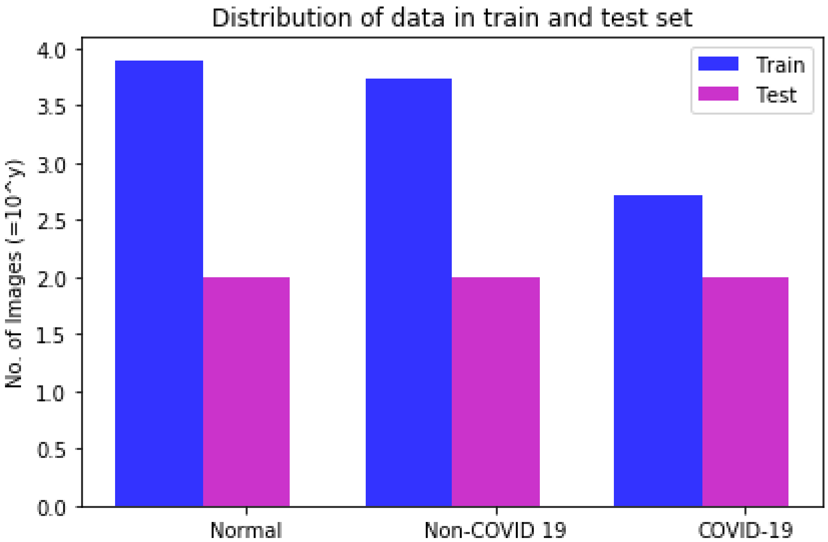

Figure 2

Distribution of COVIDx dataset in training and testing dataset. Values are represented on Y axis after taking log with base 10.

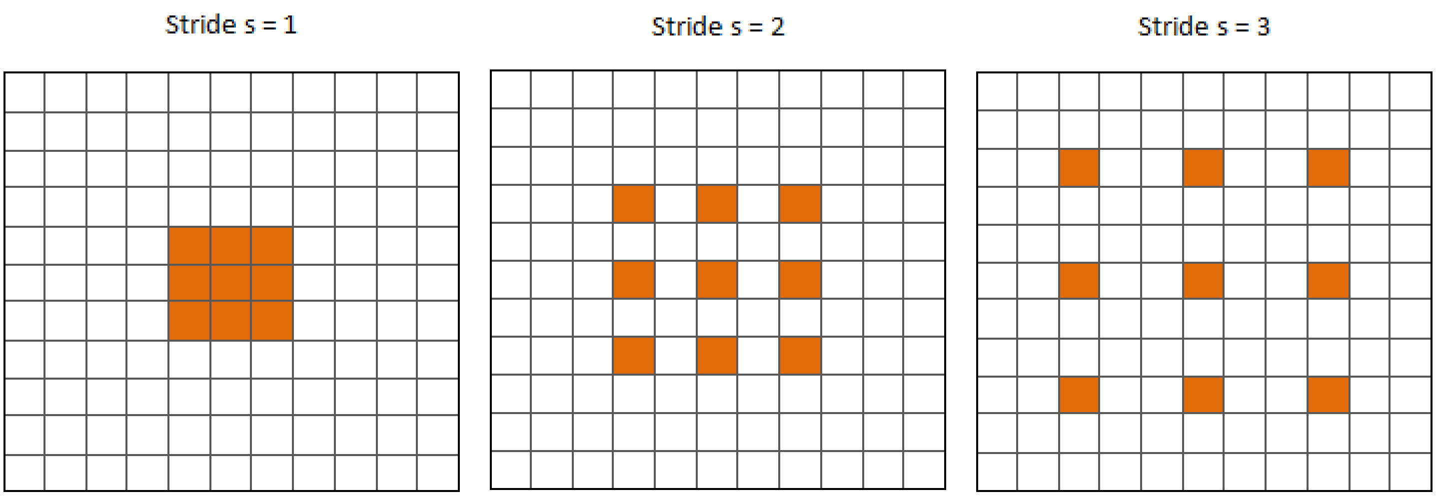

Figure 3

3x3 Dilated convolution kernel with stride s=1, 2 and 3.

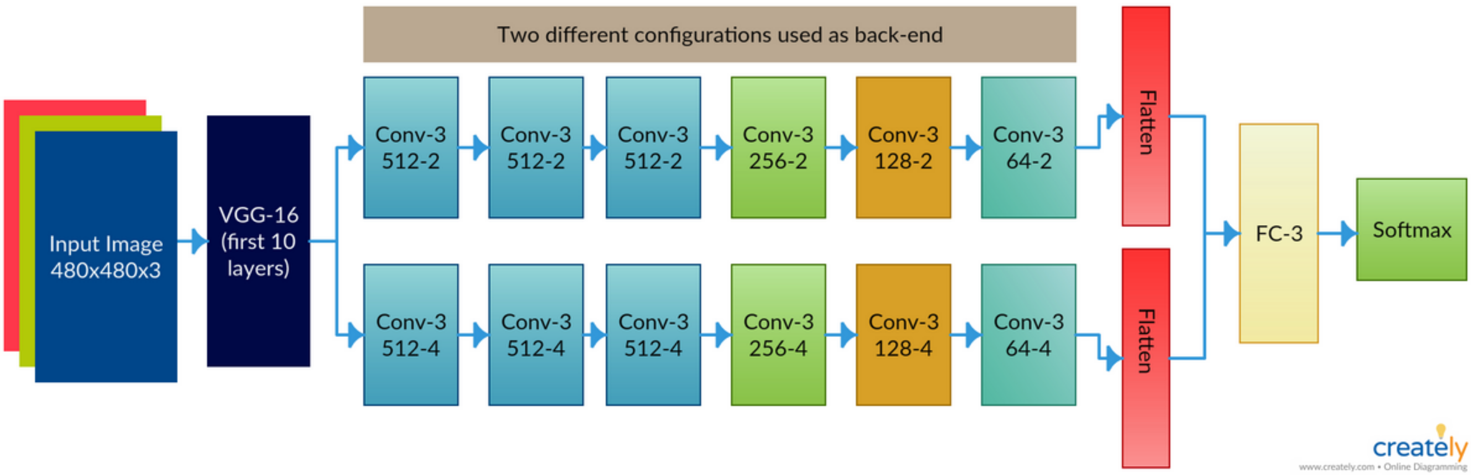

Figure 4

The proposed VGG-CovidNet hybrid architecture. The convolutional layers parameters are denoted as Conv-(kernel size) and the second line represents (number of filters)-(dilation rate).

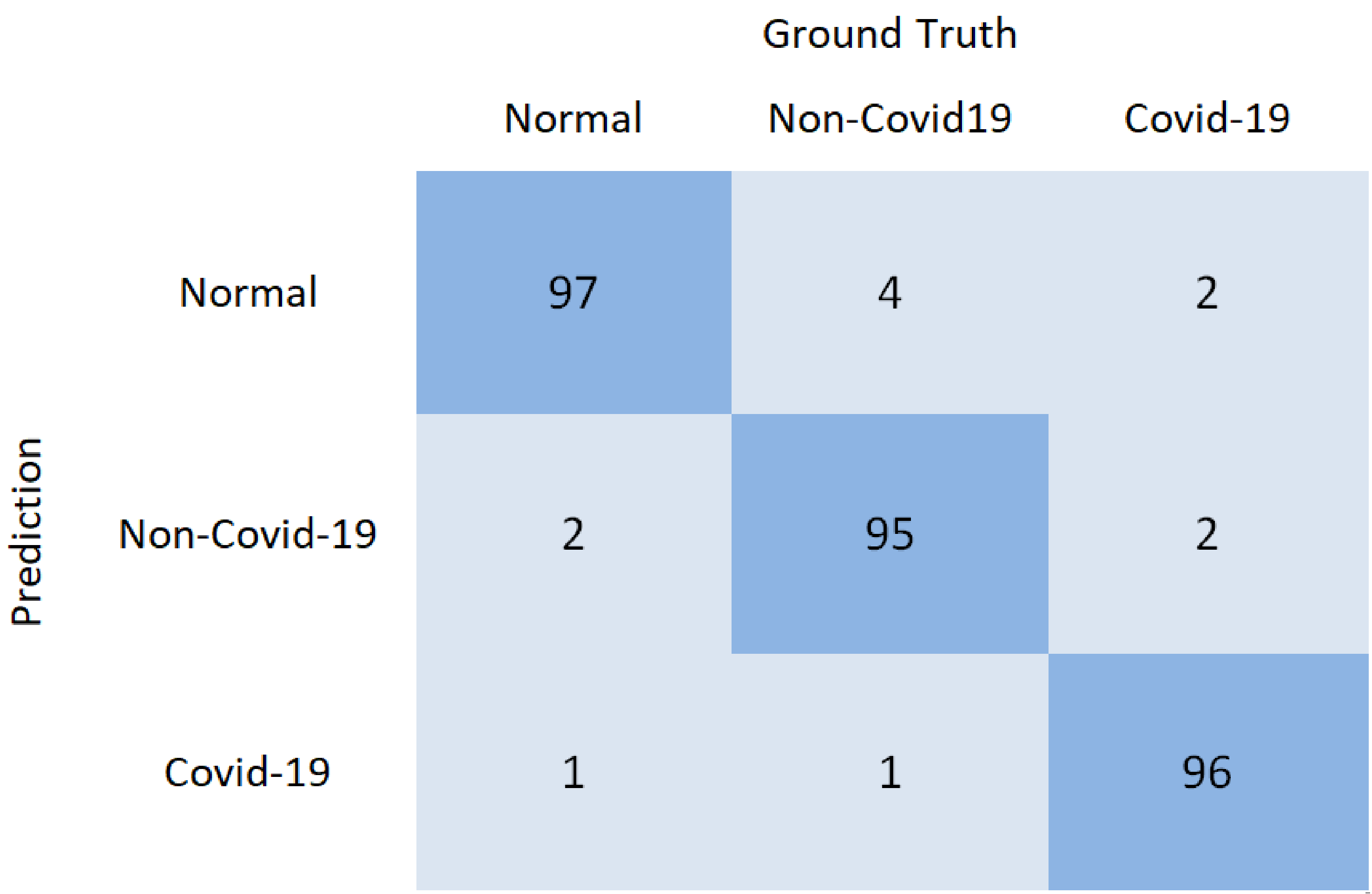

Figure 5

Confusion matrix for the proposed model on the COVIDx test dataset.